

HMI Berlin

St Petersburg

Studsvik

Dubna

FZ Jülich

Delft

Isis

Orphée

ILL Grenoble

FRM-II

PSI Zurich

KFKI Budapest

Řez  
Prague

Innovative Science  
at European Neutron  
Scattering Facilities

ILL – where we are now !

The positioning  
of ILL and the  
new Road map

• The Millennium Programme is where we  
are going



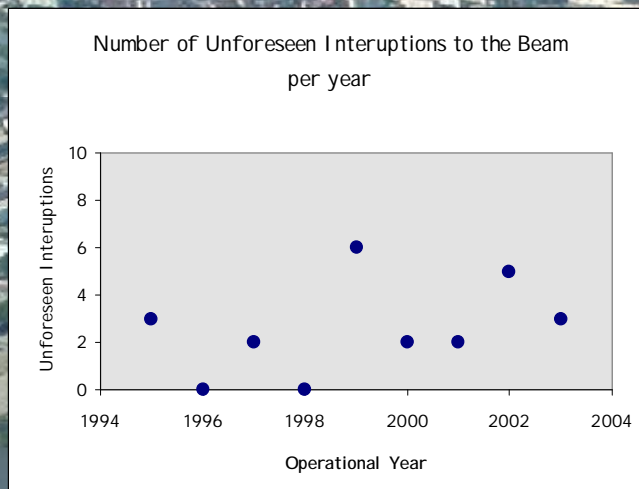


# What's happening at ILL ?

The Millennium Programme & Seismic Refit going well

ILL is Positioning itself in Europe and the World

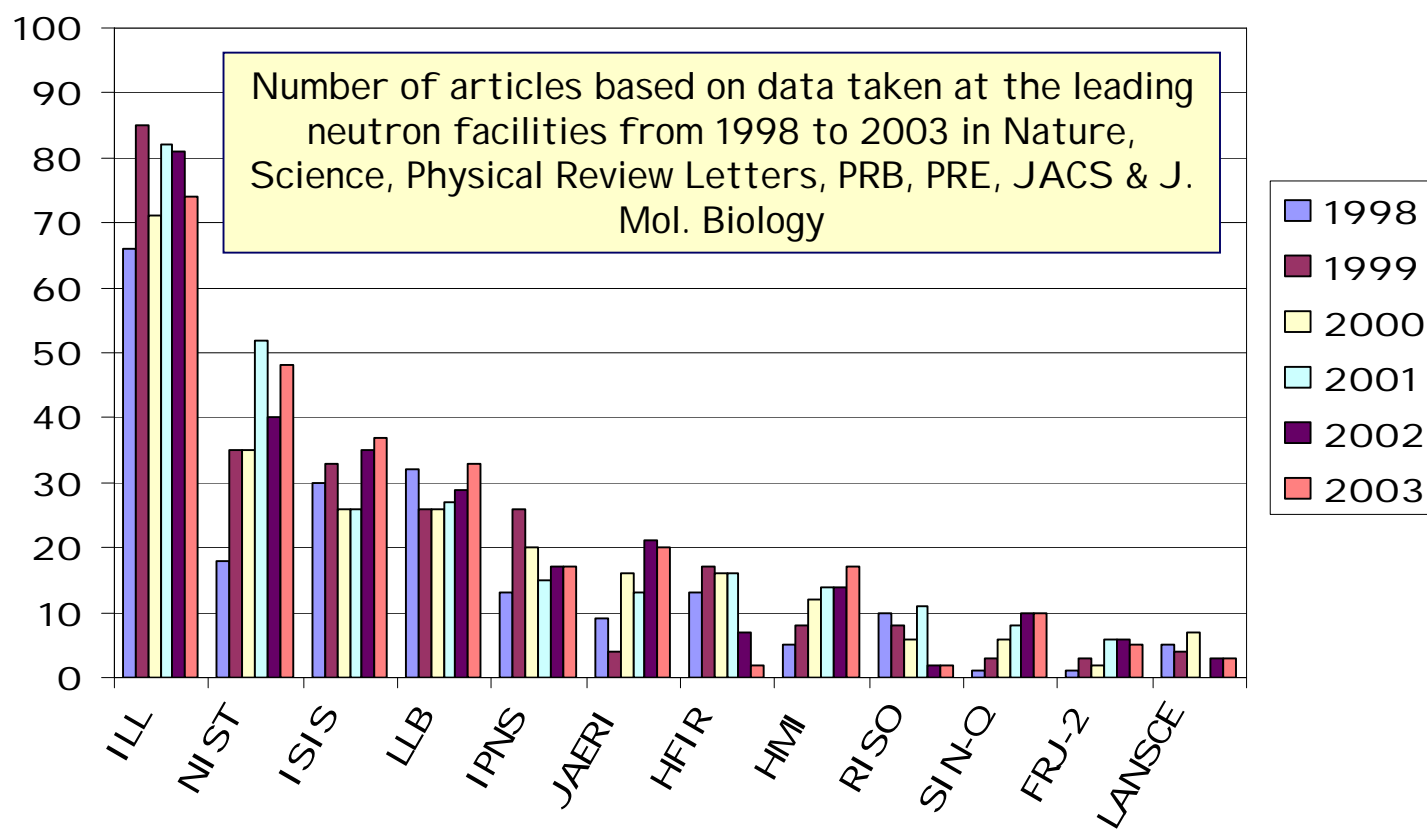
ILL is reliable for the User & the Science is good



We are working on a  
120 M€ Medium Term  
Development Plan



# ILL is positioning itself in Europe and the World...



Tokai



# ILL medium term development plan



# The ILL reactor – 58 MW

## Facilities at ILL

25 Public instruments  
11 CRG instruments  
5 Test beams

Operates 225 days per year (but 150 for 2003 - 2005)  
Delivers about 6500 instrument-days for science  
Cost per instrument-day about 10 k€

Researcher-visits 1700  
Experiments 700  
Publications 450

Lifetime to 2024 at least

Čerenkov Radiation



# Building on our Strengths Today



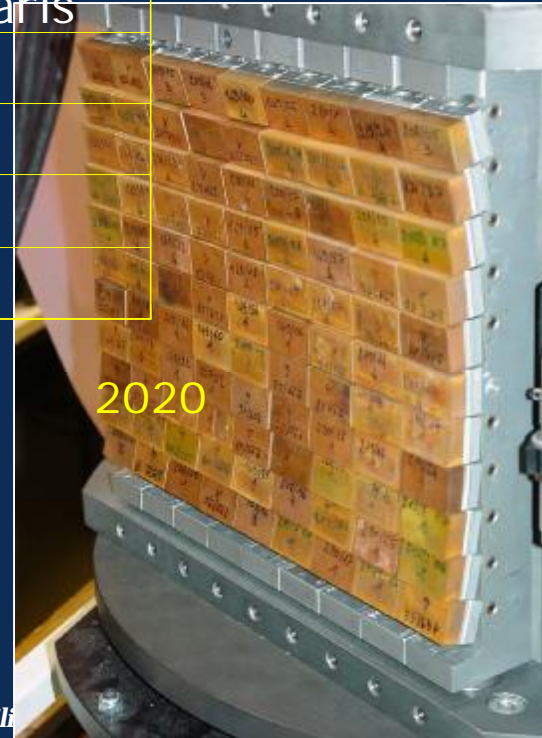
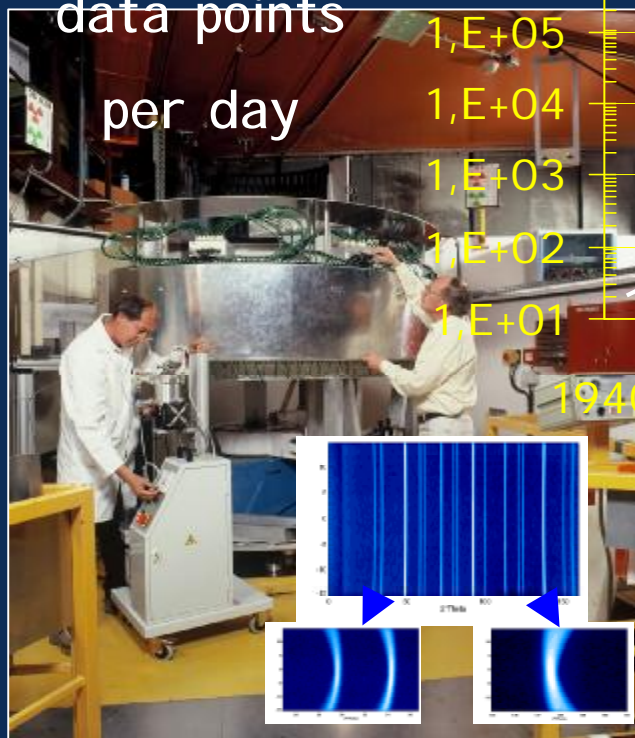
## Focussing Monochromators & Area Detectors

DRACULA



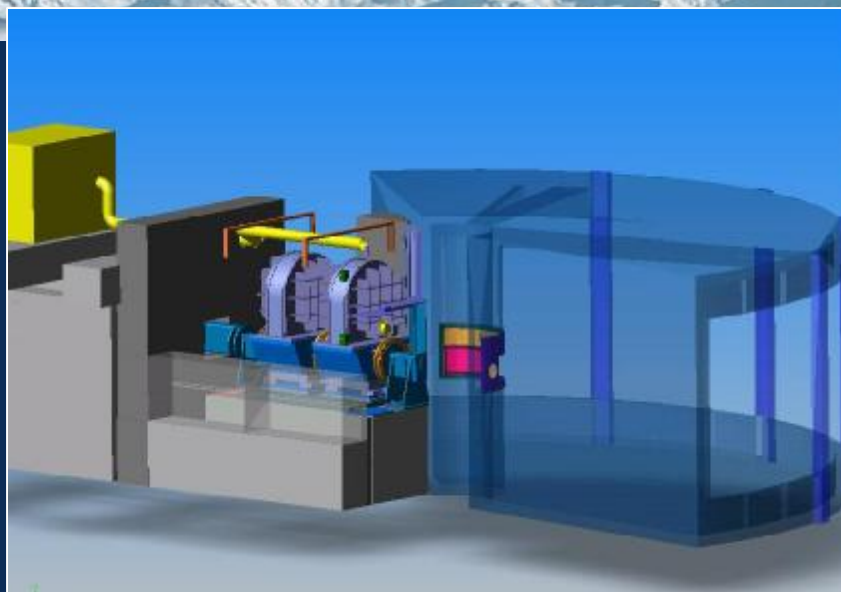
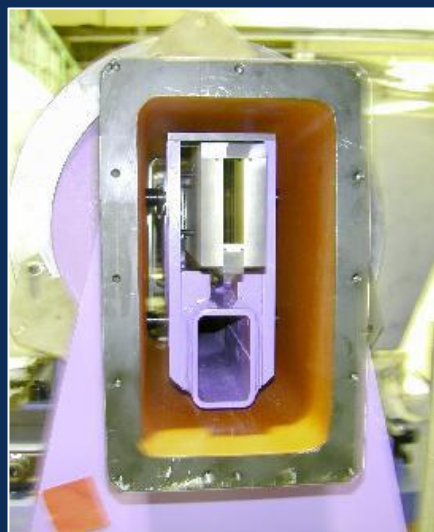
POWERGEN

Number of  
data points  
per day

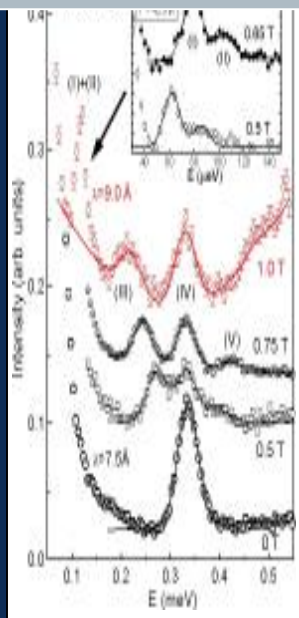


# Rebuild I N5 Secondary Spectrometer

Primary - gain 10 to 15  
recently achieved

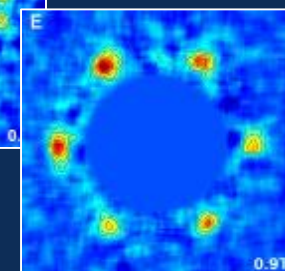
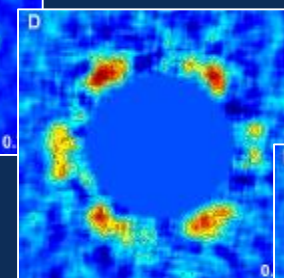
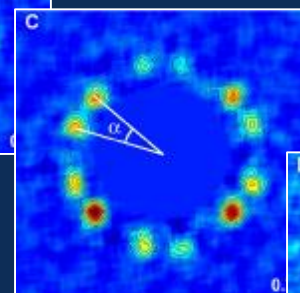
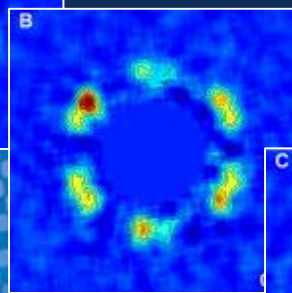
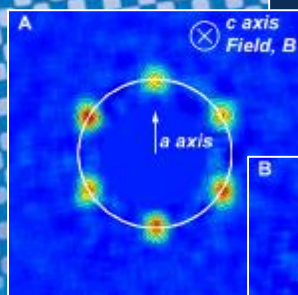


Secondary -  
gain 6 to 8  
to be achieved





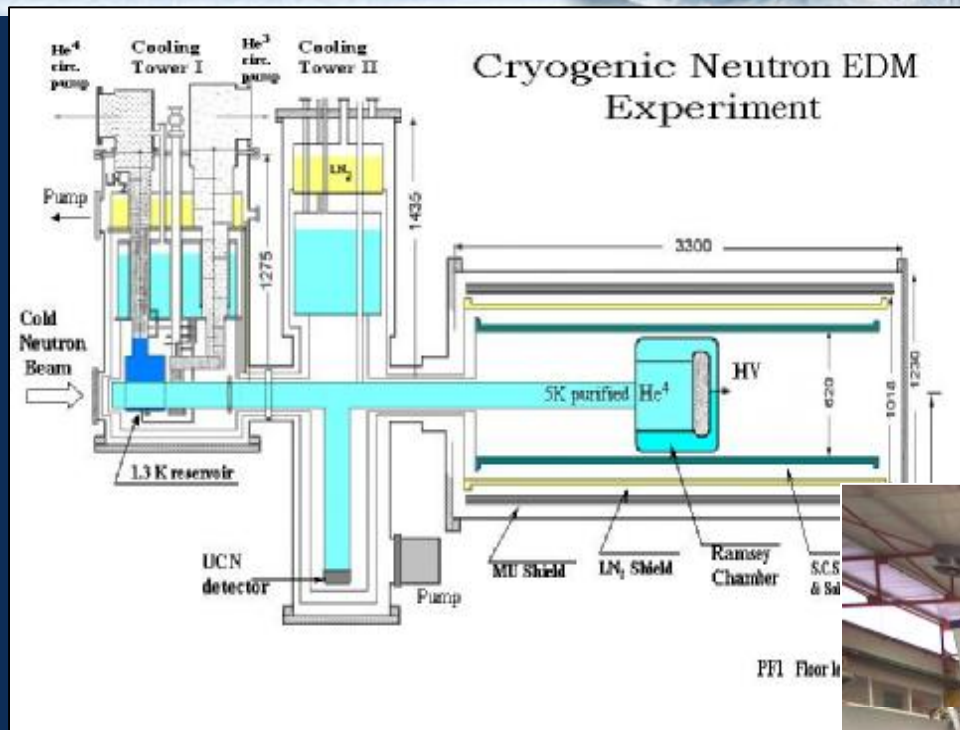
# Flux Line Lattices in High $T_c$ s by Small Angle Scattering



Count limit lifted  
from 50 kHz to 12 MHz

MgB<sub>2</sub> single crystal  
95% B<sup>11</sup> enriched  
**98μg !!**  
0.75mm<sup>2</sup>x30μm

# Electric Dipole Moment using 9.83 Å Neutrons



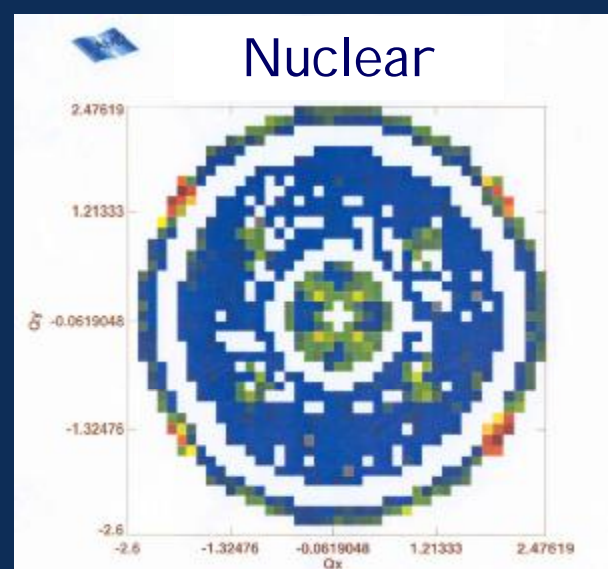
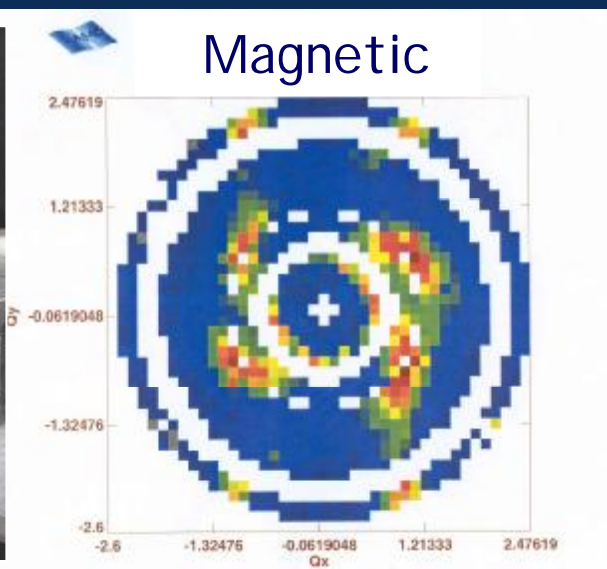
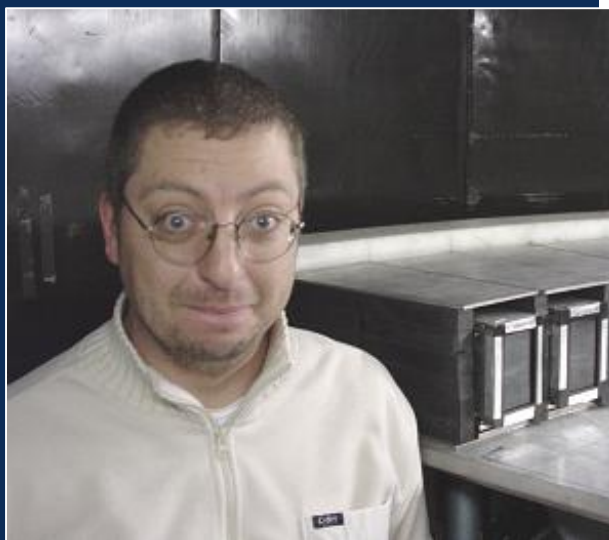
Cryo-edm set-up  
on H53

Moderation in  
superfluid helium  
from cold to ultra-  
cold neutrons

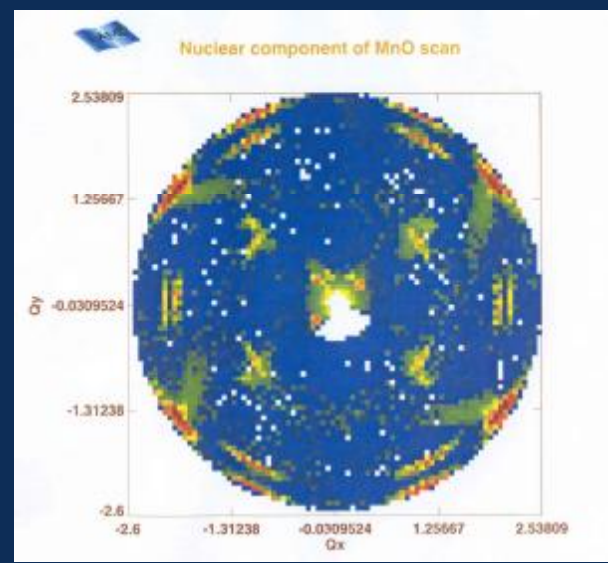
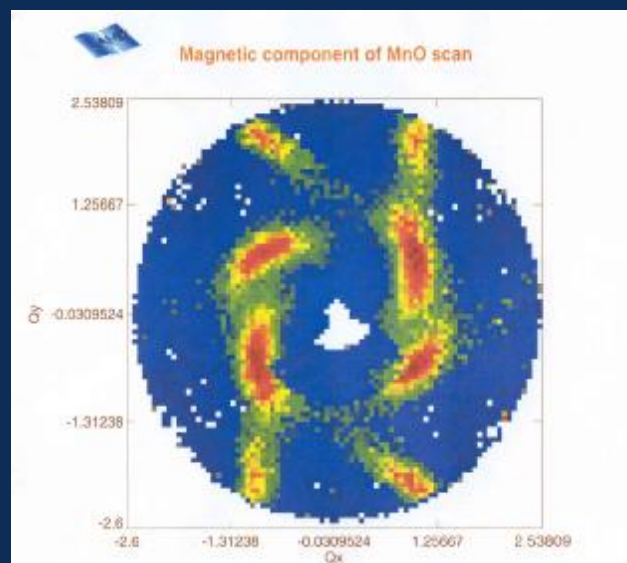




# Polarisation Analysis can be powerful – MnO

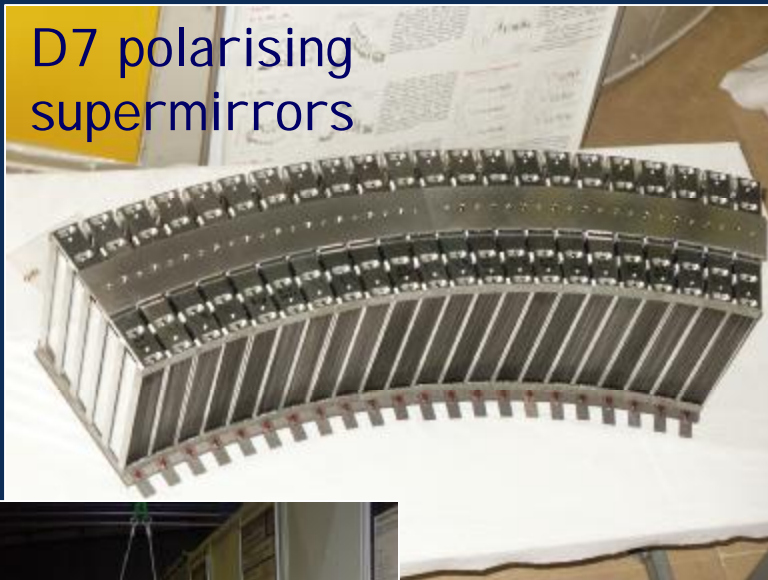


s -  
of 24  
to go



# Polarisation techniques are important

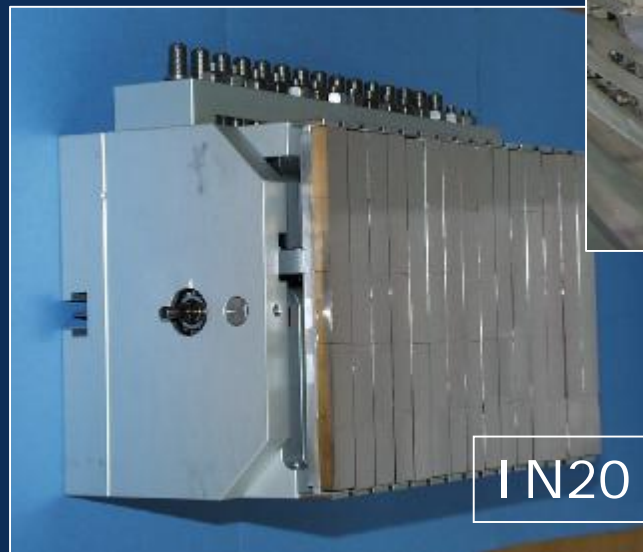
D7 polarising  
supermirrors



Cryopad



Polarising  
 $^3\text{He}$  Project



IN20 Heusler monochromator





# Science Portals



THE PARTNERSHIP FOR STRUCTURAL BIOLOGY



## The Deuteration Laboratory



Isabelle Hazemann - Strasbourg  
100mg of Aldose Reductase.  
A human enzyme which transforms  
glucose to sorbitol.  
Implicated in diabetes.

"More than simply neutrons....."

SNS Neutron Science Day 8th October 2004

Innovative Science



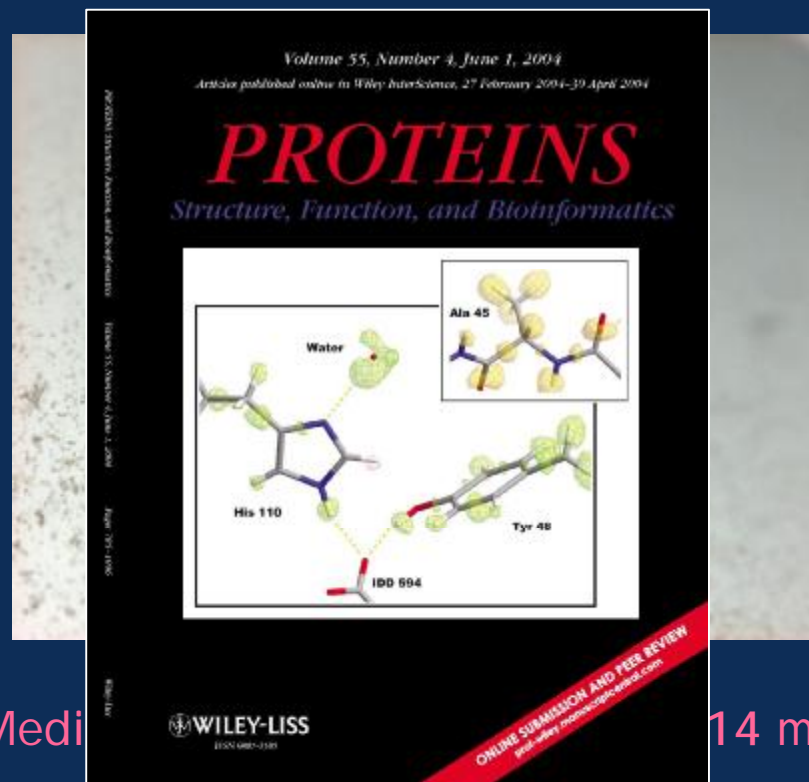
# Neutron Laue diffraction - Podjarny.

A hydrogenated protein  
partially deuterated  
by H<sub>2</sub>O / D<sub>2</sub>O exchange



Low resolution : 4.5Å, V = 0.10 mm<sup>3</sup>

A fully deuterated protein  
obtained by Deuterium culture  
(ILL – Grenoble protocol)



Medi

14 mm<sup>3</sup>



entifically ?

- Mo
- Ne
- Sp
- Ke
- Tir
- 14
- Ne
- in



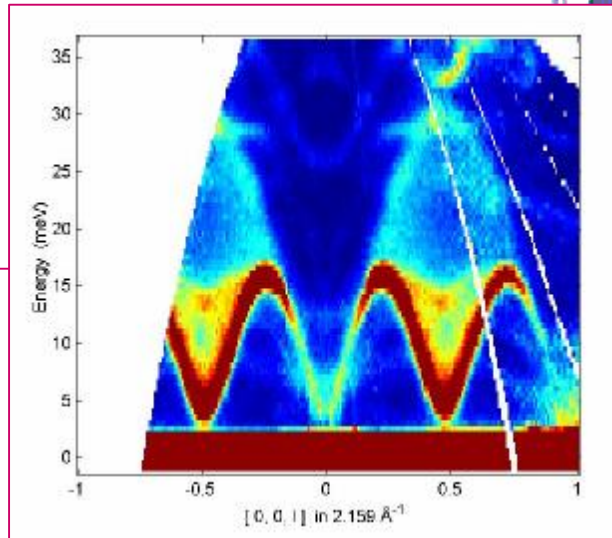
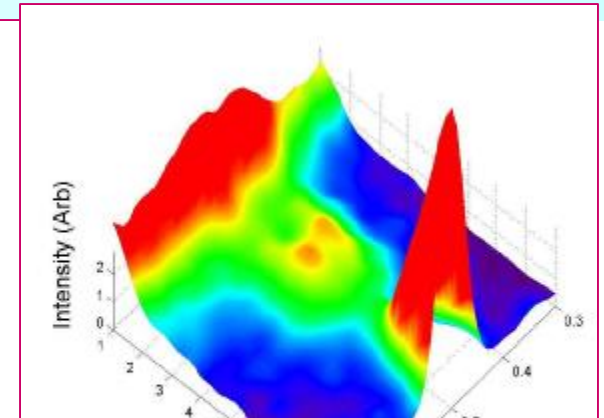
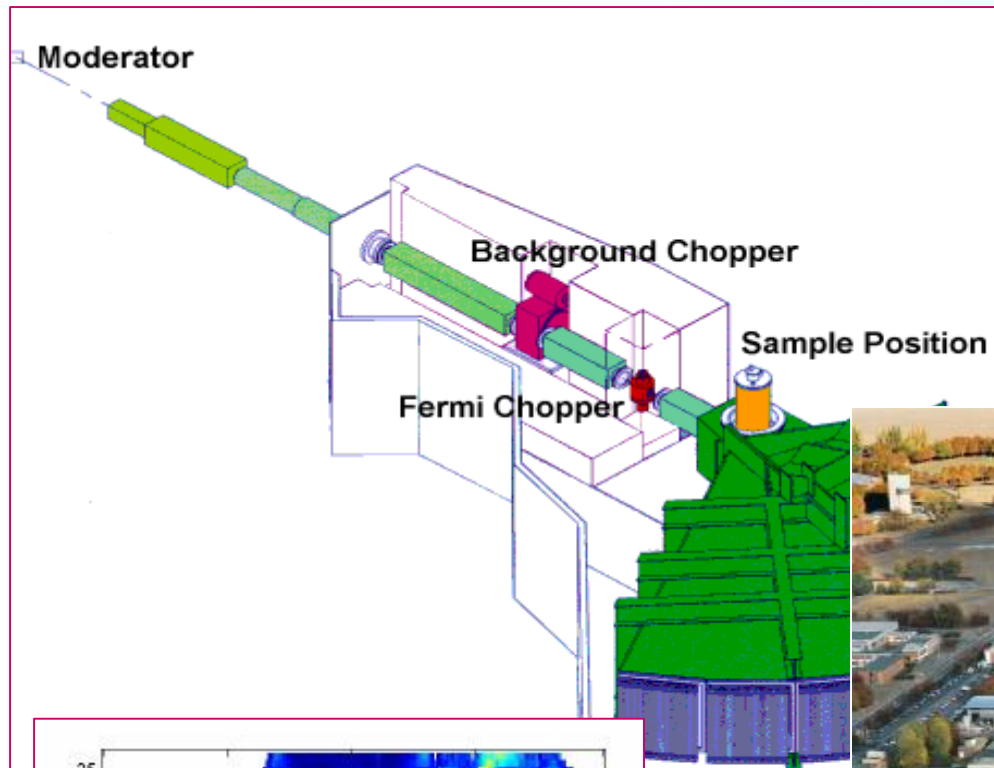
**Neutrograph**



**Neutrograph**



# Making MAPS of Magnetism





# BENS at HMI

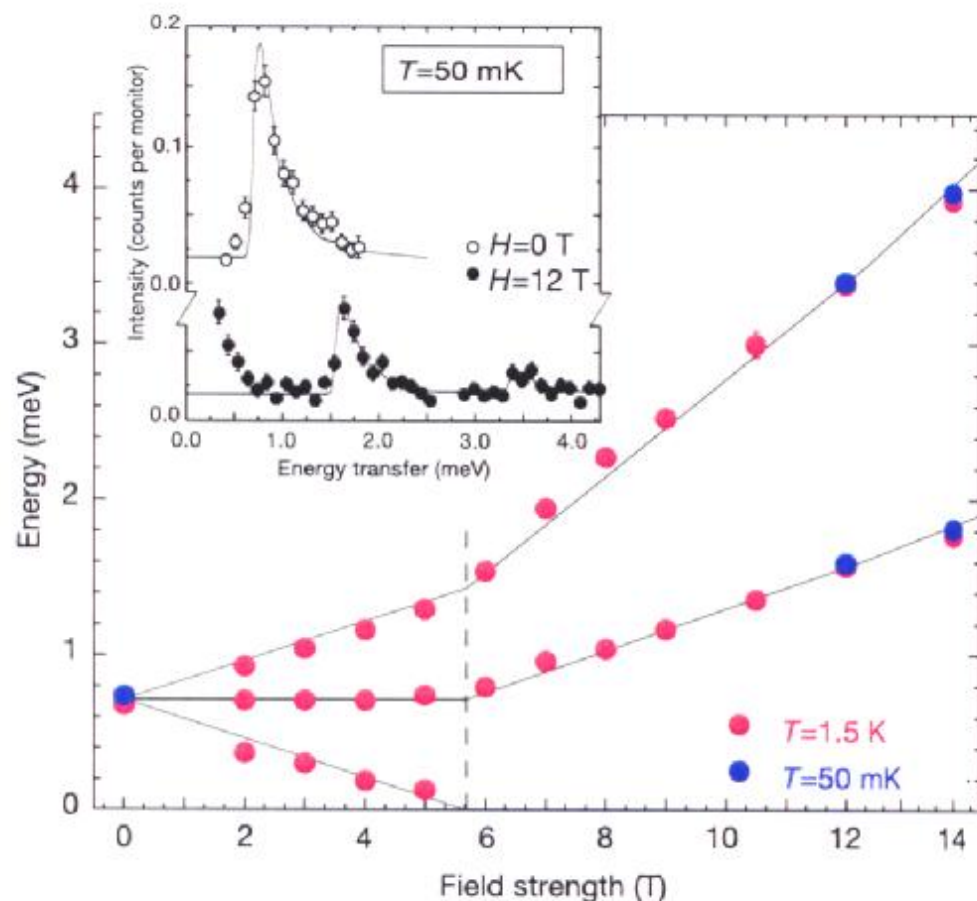
**10 MW research reactor facility with the most extensive user service in Germany**



Under construction:  
**2<sup>nd</sup> Guide Hall with 25 T Magnet**



## Magnetic field induced Bose-Einstein condensation of the triplet states in $\text{TlCuCl}_3$

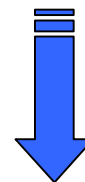


(Ch. Rüegg et al, Nature **423**, 62-65 (2003))

Field induced Bose-Einstein condensation demonstrated by high-field inelastic neutron experiments at BENSC

Neutron scattering at high magnetic fields up to 17 T:

Specialty of BENSC



New opportunities in the

- study of magnetism
- correl. electron systems
- ...

In the future: 25 T

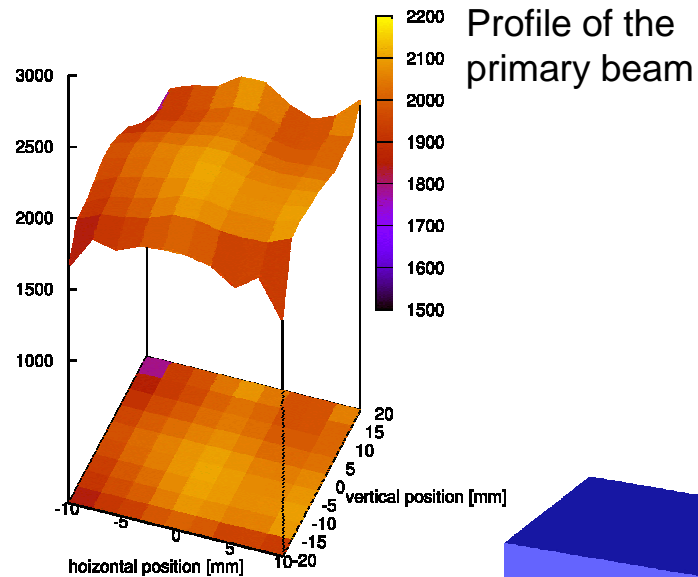




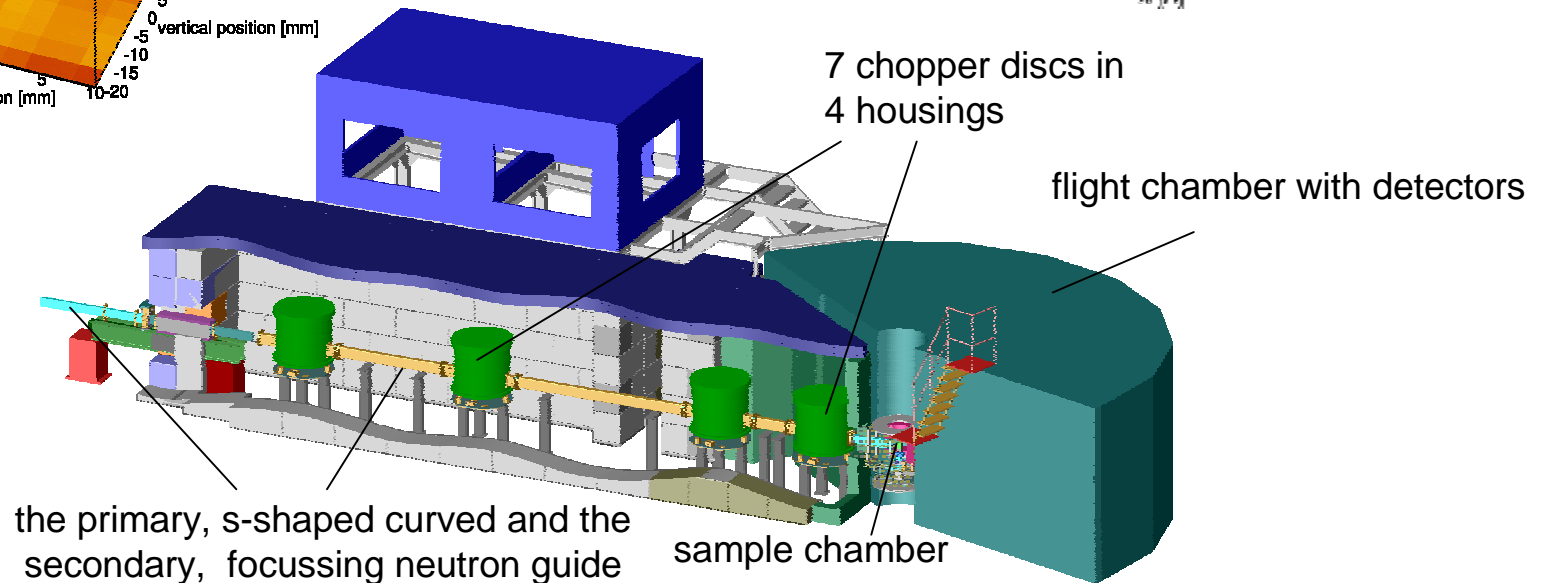
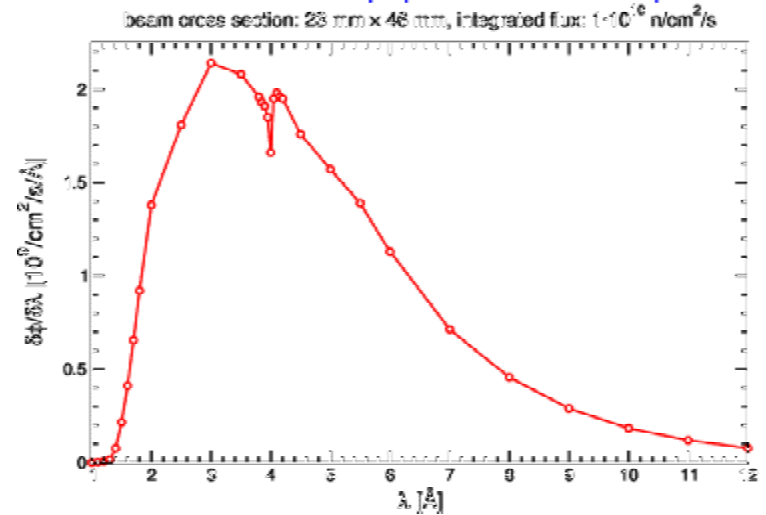
FRM-II Munich

# First spectral flux measurements at the time-of-flight spectrometer TOFTOF of the FRM-II

Intensity [arbitrary units]



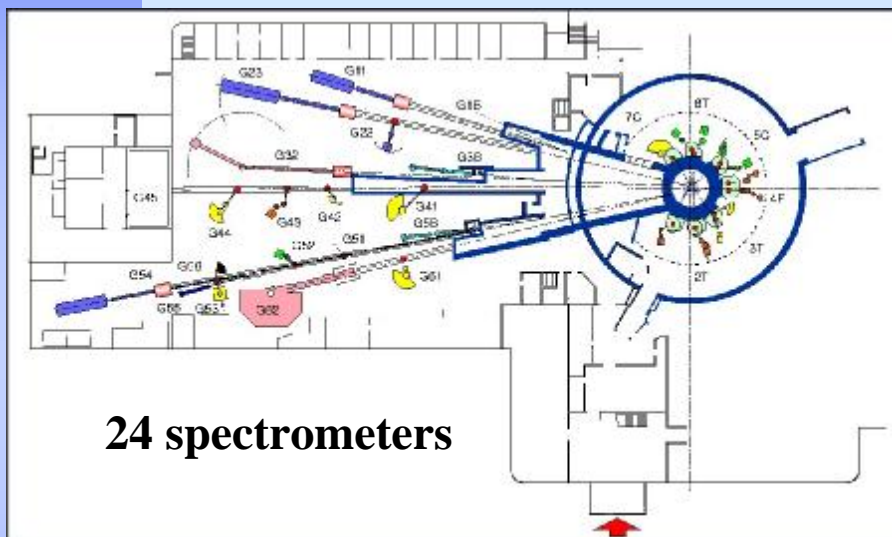
Differential neutron flux at sample position of the TOFTOF spectrometer







# Laboratoire Léon Brillouin CEA-Saclay France



24 spectrometers



*Orphée : a 14 MW reactor*



*Instruments inside the containment*



*View of neutron guide hall*



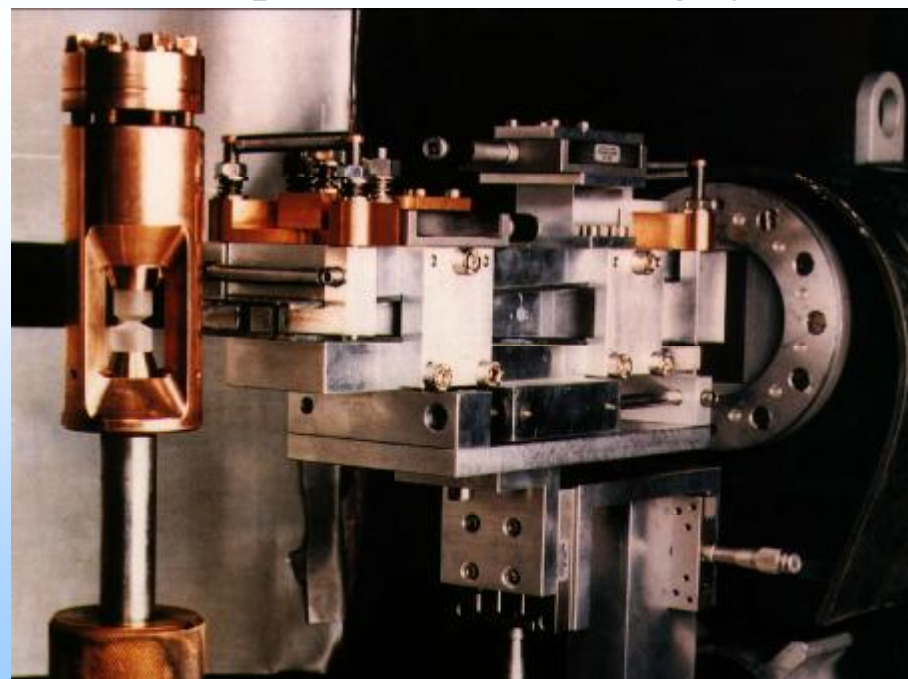


Cells for diffraction  
(sample volume  $< 0.1\text{mm}^3$ )

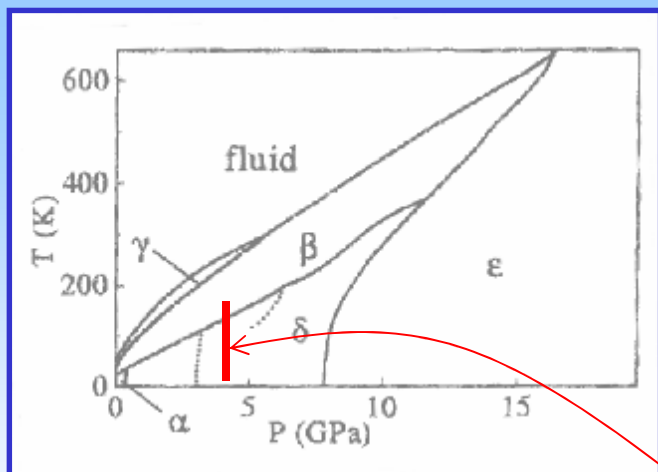
Enable high pressure,  
low temperature and  
high magnetic field at  
the same time

Aiming for  
diffraction at 400  
kbar

G61 Supermirrors focussing system





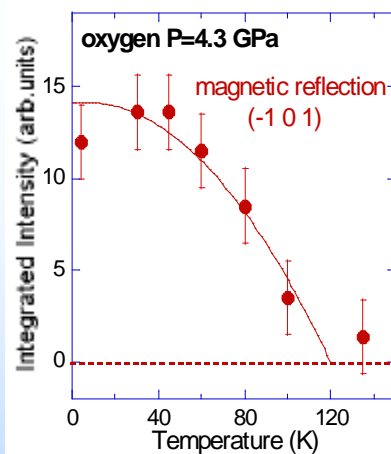
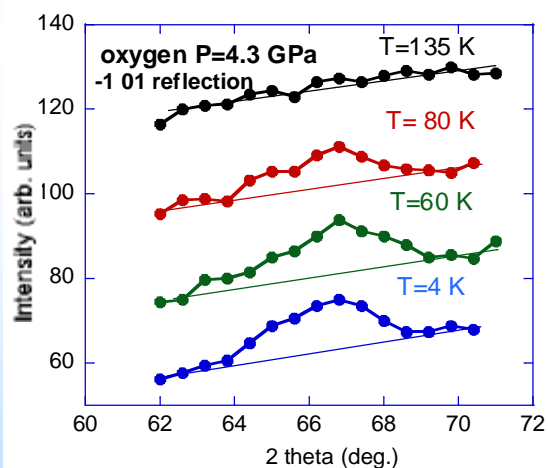


*Oxygen phase diagram*

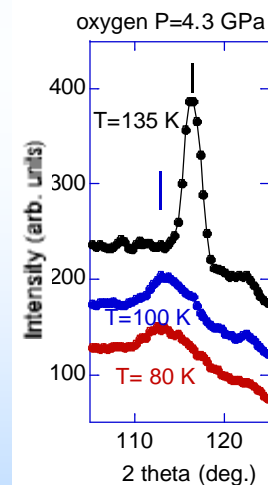
## Magnetic order of solid oxygen at P=43 kbar

*Measurements along this line*

### Magnetic reflection



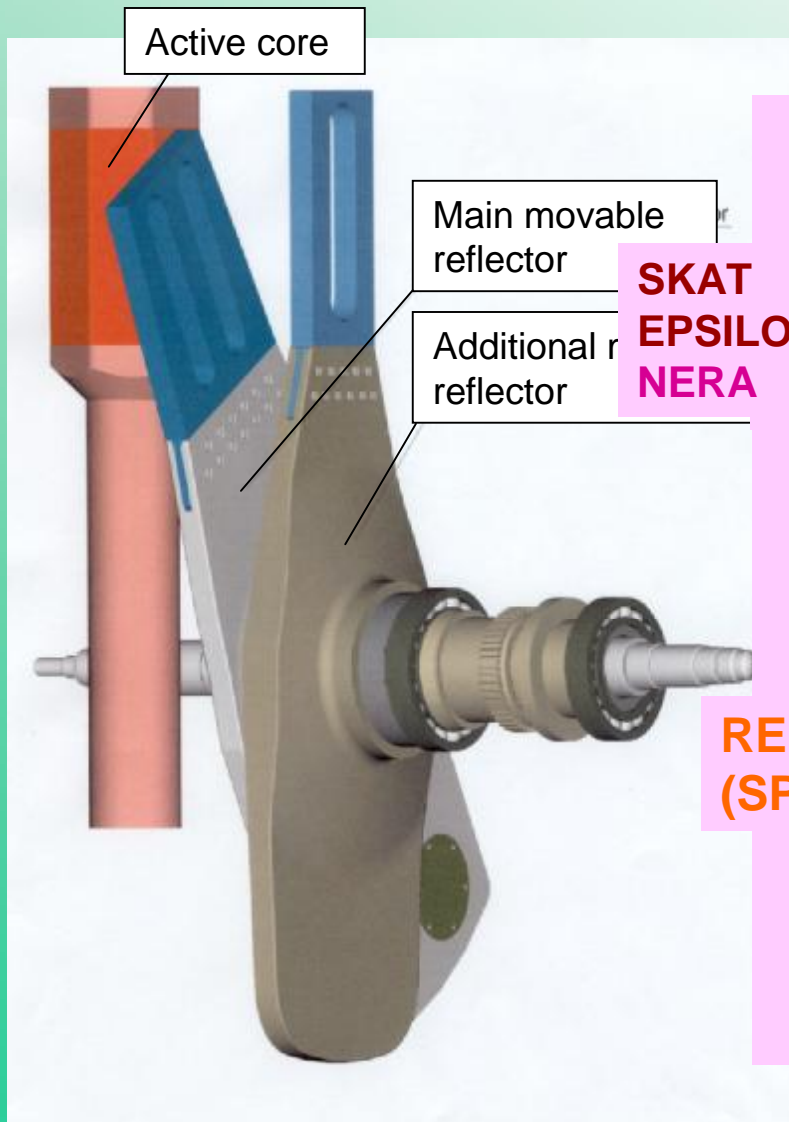
### Structural reflection



**Magnetic transition coincides with the structural transition.**

*I. Goncharenko*

# IBR-2 pulsed reactor FLNP JINR, Dubna



SKAT  
EPSILON  
NERA

REMUR  
(SPN)

HRFD

DN-2  
TEST

YuMO

DIN-2PI

KOLHI

REFLEX

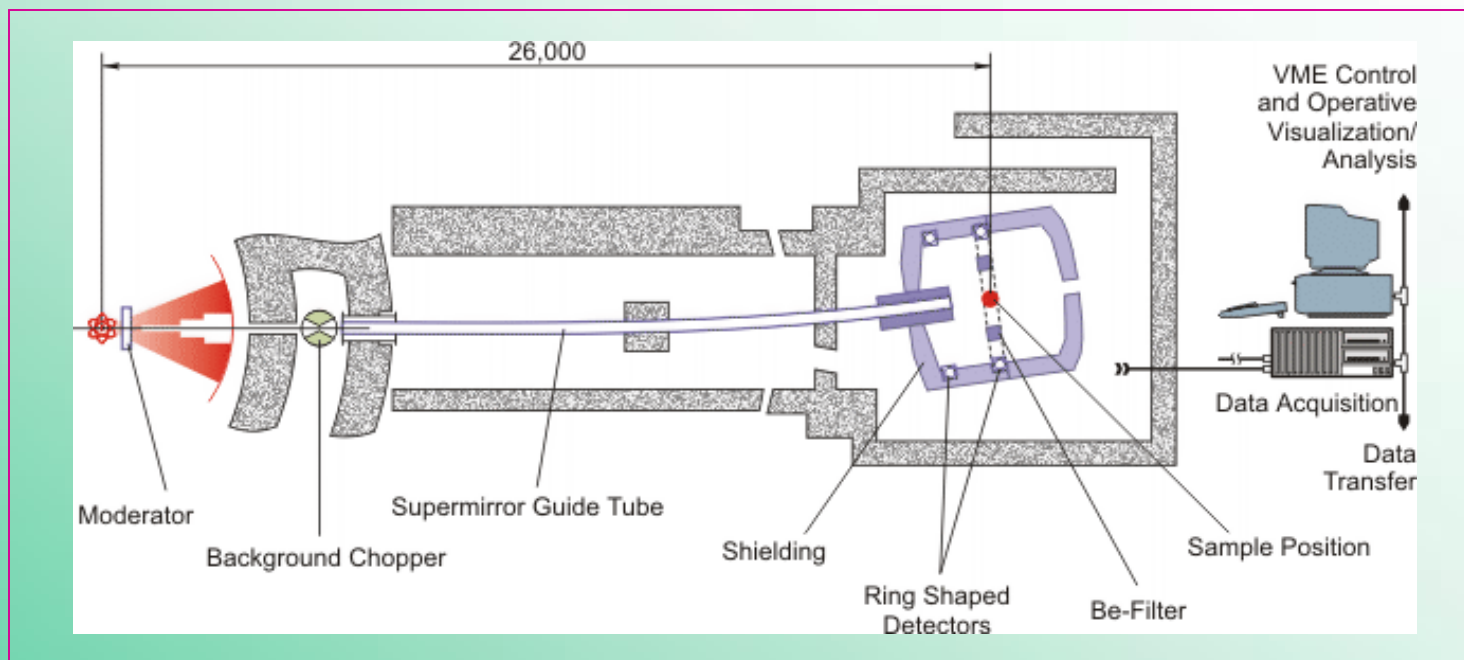
KDSOG

FSD  
IZOMER

DN-1

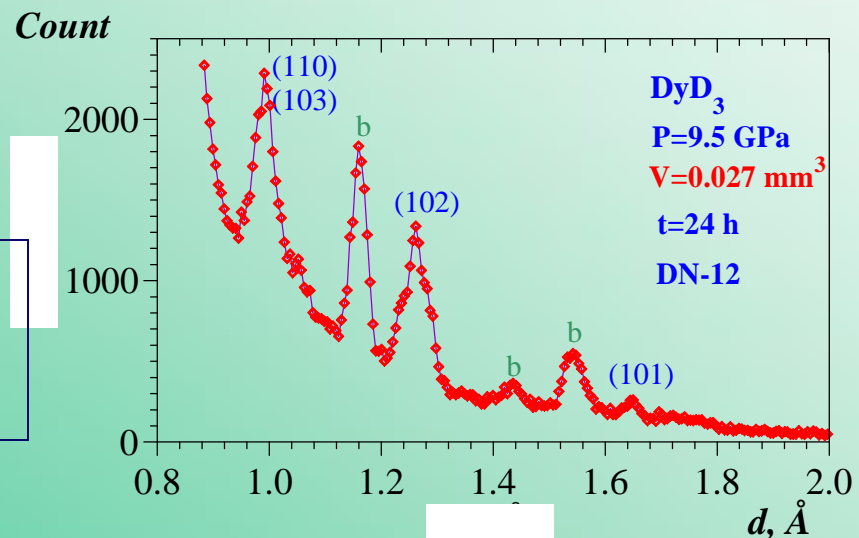


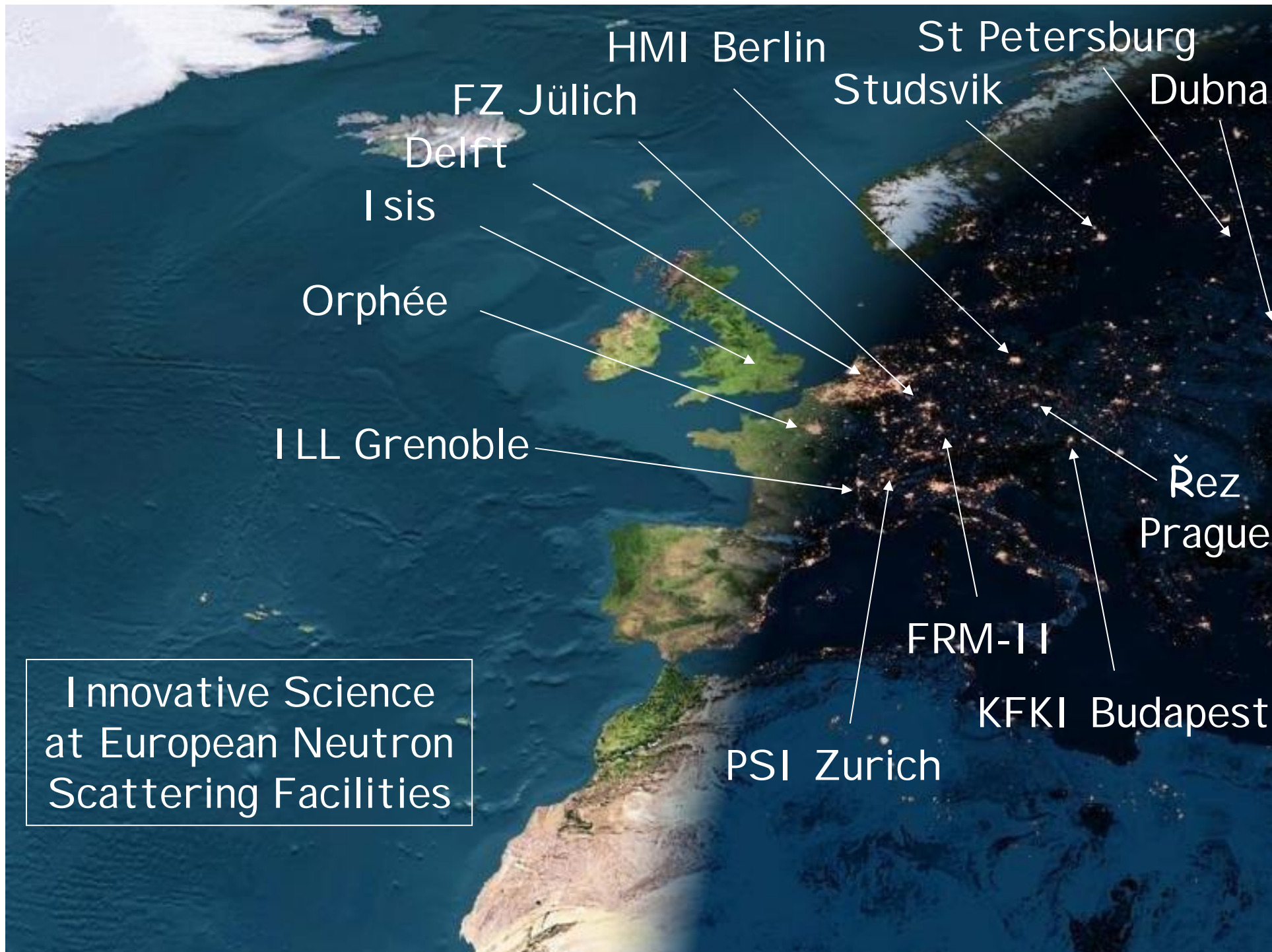
# Diffractometer DN-12 for high pressure research at IBR-2



Saphire anvil high-pressure cell, P up to 70 kbar (cylinder 48 mm  $\varnothing$  x 164 mm height).

Experimental diffraction pattern from microsample of  $\text{DyD}_3$  under high pressure obtained at DN12





Innovative Science  
at European Neutron  
Scattering Facilities